

Claims

1. A sealing device (21;41;61;71) for use in ophthalmic surgery to replace a catarcteous and/or presbyopic natural lens, comprising a flexible plug part (23;43;63;77) adapted to seal a capsulorhexis (30;75) of a capsular bag (28;73), while admitting the entrance of injection device for injecting a lens-forming liquid material through the capsulorhexis (30;75), said plug part (23;43;63;77) having slightly larger area than the capsulorhexis (30;75) and is made of a deformable polymer, wherein said sealing device (1;21;41;61;71) further comprises an anteriorly protruding removable adjusting means (25;45;65), connected to the plug part (23;43;63;77) capable of positioning said plug part (23;43;63;77) to a desired location.
2. A sealing device according to claim 1 characterized in that it is free from any parts protruding out from the capsular bag subsequent to the surgical process.
3. A sealing device according to claim 1, wherein said plug part (23;43;63;77) is essentially disc-shaped.
4. A sealing device according to any one of the preceding claims, wherein said plug part (23;43;63;77) is adapted to be placed at the inside of the capsular bag (28;73), covering the whole capsulorhexis (30;75).
5. A sealing device according to any one of the preceding claims, wherein said plug part (32;43;63;77) being made of a suitable soft material and being enough thin for following the accommodation movements of the capsular bag.
6. A sealing device according to any one of the preceding claims, wherein said plug part (23;43;63;77) is made of a silicon material.
7. A sealing device according to any one of the preceding claims, wherein said plug part (23;43;63) is made of a material having essentially the same refractive index as the material inserted in the capsular bag (7;28).

8. A sealing device according to claim 1, wherein the plug part is provided with contacting means to capsular bag so as to ensure that a correct accommodating process is established.
- 5 9. A sealing device according to claim 8, wherein said contact means consists of a friction enhanced part of the anterior surface of the posterior plug.
10. A sealing device according to claim 9, having a roughened surface (47) on at least the surface contacting the inner wall of the capsular bag (7;28).
- 10 11. A sealing device according to claim 1, having an anteriorly extending ring (67) in the middle with a diameter fitting into the rhexis from below, the ring (67) being adapted to stabilize the position of the sealing device (61) in the rhexis.
- 15 12. A sealing device according to claim 1, wherein the removable adjusting means (25;45;65) is at least one flexible thread (25;45) attached to the plug part (23;43;63).
- 20 13. A sealing device according to claim 12, wherein the at least one thread (25;45;65) protrudes in an anterior direction from the plug part (23;43;63).
14. A sealing device according to claim 13, wherein said at least one thread (25;45;65) is of such a length that it protrudes to outside the eye and can be
25 manipulated from outside the eye.
15. A sealing device according to any one of the preceding claims, wherein the plug part (43) has a cut (49) admitting passage of the lens-forming material.
- 30 16. A sealing device according to claim 15, wherein the cut (49) is provided with an overlapping part (51) adapted to seal the cut (49) when the injection is completed.

17. A sealing device according to any one of the preceding claims, being adapted to be positioned in a rhexis (9;75) of about 1 mm in diameter positioned off the optical axis of the eye.
- 5 18. A sealing device according to any one of the claims 1-17, being adapted to be positioned in a rhexis (30) of more than 1 mm in diameter positioned to include the optical axis of the eye.
- 10 19. A sealing device according to any one of the preceding claims, being adapted to remain in the capsular bag (28;75) after the intraocular lens-forming process is completed.
- 15 20. A sealing device according to claim 18 or 19, wherein said plug part (32;43) being optically clear.
21. A sealing device according to claim 18, wherein said plug part (32;43) covers the whole path of light that is admitted by the pupil.
- 20 22. A sealing device according to claim 21, being designed to compensate for aberration.
23. A sealing device according to any one of the claims 21 or 22, being designed to correct for error of refraction in the eye.
- 25 24. A sealing device according to any one of the claims 1-23, being adapted to be removed after the intraocular lens-forming process is completed.
25. A method of obtaining visual correction subsequent to surgically removing the natural lens **characterized by** the steps of:
 - 30 - inserting a plug part (23;43;63;77) of a sealing device (21;41;61;71) through a capsulorhexis (30;75), said plug part (23;43;63;77) being adapted to cover the capsulorhexis (30;75) from the inside of the capsular bag (28;73);
 - adjusting said the location of said plug part (23;43;63;77) with an adjusting means (25;45;65) operable from the outside of the capsular bag (28;73);

- delivering a lens-forming material through the capsulorhexis (30;75) into the capsular bag (28;73) by using a delivering means and by displacing and/or deforming the plug part (23;43;63;77) to admit passage for the material;
- removing the delivering means out from the eye, whereby the plug part (23;43;63;77) retains sealing position (30;75), thereby preventing displacement of the lens-forming liquid material out from the capsular bag (28;73).

26. A method according to claim 25, further comprising the step of removing the sealing device (21;41;61;71) through the capsulorhexis (30;75) when the lens-forming process is completed.

27. A method according to claim 25, comprising the step of removing the adjusting means (45;65) when the plug part seals the capsulorhexis (30;75) by the influence of the lens-forming material in the capsular bag (7;28;73).

28. A method according to any one of the claims 25 to 27, comprising the step of controlling the position of said plug part (23;43;63;77) by means of the adjusting means (25;45;65).

29. A method according to any one of the claims 25 to 28, comprising the step of delivering the lens-forming material to the capsular bag (28) through a cut (49) in the plug part (43) and through the capsulorhexis (30).

30. A method according to any one of the claims 25 to 29, further comprising measuring the error of refraction of the eye and optionally selecting a sealing device having a plug part capable of least partially to compensate for an error of refraction.

31. A method according to any one of the claims 25 to 30, further comprising measuring the corneal topography of the cornea and thereby the amount aberrations of a wavefront arriving from the cornea and selecting a sealing device having plug part with at least one surface that is capable compensate for at least one such aberration.

32. A method according to any of claims 25 to 31, including estimating at least one aberration of the lens to be formed in the capsular bag and selecting a sealing device having plug part together with said implanted lens can compensate for at least on such aberration.

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33. A method according to claim 25, comprising introducing an agent capable of counteracting the formation of a secondary cataract by epithelial cell growth on the capsular bag inner wall, before delivering the lens forming material.

10 34. A method of performing visual correction in a patient by replacing the natural lens with a lens implant comprising:

- a) excising an area of the anterior capsular bag of the eye having a sufficient size to surgically remove the natural lens;
- b) locating a sealing device comprising a flexible plug part and removable adjusting means of a size sufficient to cover said excised area with said adjusting means to a position where a peripheral anterior surface of said plug part contacts the inner (posterior) wall so as to sufficiently cover said excised area;
- c) delivering a lens filling material into the capsular a bag by using a delivering means to temporarily displace and/or deform said plug part to admit passage into the capsular bag of said material;
- d) before removing the delivery means, introducing lens forming material into the capsular bag to an extent that said material exerts a sufficient pressure on the posterior side of the plug part to seal the excised area, so said lens material is prevented from being displaced from the capsular bag to the posterior chamber of the eye; and
- e) finalizing the lens forming process in the eye.

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35. A method according to claim 34, wherein said excised area is intersected by the optical axis.

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36. A method according to claim 35, wherein said excised area has a largest diameter that essentially extends over the visual field.

37. A method according to claim 34, comprising removing the adjustment means of the sealing device from the eye after completing the introduction of lens forming material into the capsular bag.
- 5 38. A method according to claim 34, comprising removing the adjustment means of the sealing device from the eye upon finalizing the lens forming process.
39. A method according to claim 34, comprising introducing an agent capable of counteracting the formation of a secondary cataract by epithelial cell growth on the capsular bag inner wall, before introducing the lens forming material.
- 10 40. A method according to claim 34, comprising the step introducing the lens-forming material to the capsular bag through a cut in the plug part.
- 15 41. A method according to claim 34, comprising measuring the corneal topography of the cornea and thereby the amount aberrations of a wavefront arriving from the cornea and selecting a sealing device having a plug part with at least one surface that is capable compensate for at least one such aberration.
- 20 42. A method according to any of claim 41, including estimating at least one aberration of the lens to be formed in the capsular bag and selecting a sealing device having plug part together with said implanted lens can compensate for at least on such aberration.
- 25 43. A method according to claim 34, comprising introducing an agent capable of counteracting the formation of a secondary cataract by epithelial cell growth on the capsular bag inner wall, before delivering the lens forming material